



**Type BA-4C**  
**Monitoring and Recording**  
**Amplifier**

**RADIO CORPORATION OF AMERICA**  
RCA VICTOR DIVISION                      CAMDEN, N. J.

**BROADCAST EQUIPMENT**

**INSTRUCTIONS**

**Type BA-4C**  
**Monitoring and Recording**  
**Amplifier**

**(MI-11223-B)**

**RADIO CORPORATION OF AMERICA**  
**RCA VICTOR DIVISION CAMDEN, N. J.**



58778-1

Figure 1—Type BA-4C Amplifier.

## TECHNICAL DATA

### FOUR-STAGE HIGH-GAIN OPERATION

#### Power Supply

105 to 125 volts, 50 to 60 cycles, 105 watts

#### Fuse

3 amperes, type 3AG

#### Tube Kit (MI-11267)

2 RCA-1620  
1 RCA-6SN7-GT  
2 RCA-1622  
1 RCA-5R4-GY

#### Emergency Tube Kit (MI-11267-A)

2 RCA-6J7\*  
1 RCA-6SN7-GT  
2 RCA-6L6\* or 6L6-G\*  
1 RCA-5R4-GY

#### Input

Unloaded transformer

#### Source Impedance

250 or 30 ohms

#### Maximum Input Level

-27 dbm for a maximum distortion of 1% from 50 to 7,500 cps, or 2% from 30 to 15,000 cps.

#### Gain

With volume control at maximum position:

- (a) 105  $\pm$ 2 db when operating from a 250-ohm source into a 15- or 600-ohm load.
- (b) 73  $\pm$ 2 db when operating with bridging volume control from a 600-ohm terminated line into a 15- or 600-ohm load.

#### Load Impedance

The output transformer is tapped for the following load impedances:

600/250/15/7.5/5 ohms

#### Frequency Response

$\pm$ 2 db from 30 cycles to 15,000 cycles, operating from a 250-ohm source into a 15-ohm load. See figure 8.

#### Power Output and Distortion

12 watts (40.8 dbm) with total rms distortion of less than 3% from 50 cps to 7,500 cps.

#### Noise Level

Total noise level measured with a 250-ohm resistor across input terminals:

- (a) -20 dbm with volume control in maximum position.
- (b) -40 dbm with volume control in minimum position.

#### Mounting

Rack mounting on Type BR-2A or Type 36-B Panel and Shelf Assembly.

Cabinet mounting in Type LC-1A Speaker Cabinet.

#### Dimensions and Weight

Width—10 $\frac{3}{4}$  inches  
Depth—14 inches  
Height—7 $\frac{1}{2}$  inches  
Weight—21 $\frac{1}{4}$  pounds

### THREE-STAGE REDUCED-GAIN OPERATION

#### Tubes

1 RCA-1620 or 1 RCA-6J7\*  
1 RCA-6SN7-GT  
2 RCA-1622 or 2 RCA-6L6\* or 6L6-G\*  
1 RCA-5R4-GY

#### Gain

With volume control at maximum position:

- (a) 71 db when operating from a 250-ohm source into a 15-ohm or 600-ohm load.
- (b) 39 db when operating with bridging input into a 15-ohm or 600-ohm load.

\* 6J7's may be substituted for RCA-1620's and 6L6's, or 6L6-G's for RCA-1622's when maximum uniformity of characteristics and minimum of microphonics, hum and distortion are not required.

#### Maximum Input Level

-24 dbm

#### Power Output

Unchanged

#### Frequency Response

Unchanged

#### Noise Level

Total noise level with a 250-ohm resistor across the input:

- (a) -40 dbm with volume control in maximum position.
- (b) -60 dbm with volume control in minimum position.

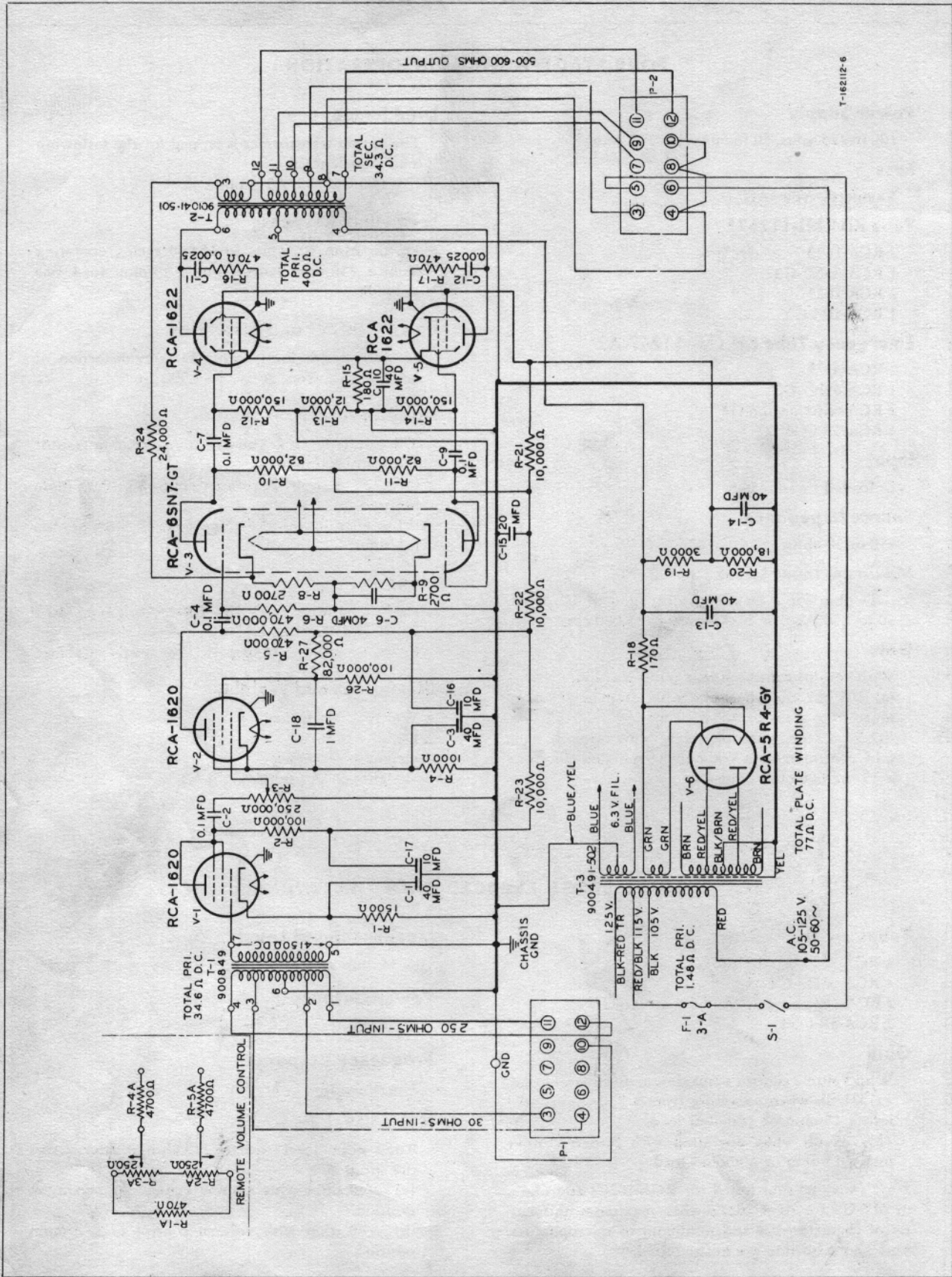


Figure 2—Schematic diagram of BA-4C.

## DESCRIPTION

### General

The Type BA-4C (MI-11223-B) Monitoring and Recording Amplifier is a four-stage, resistance-capacity-coupled unit of the plug-in type with a self-contained power supply. The amplifier has high fidelity and high-gain characteristics which make it suitable for monitoring, recording and audition applications. It may be used in emergencies as a program or line amplifier. It is suitable for use in transcription playback booths, since the 105-db gain is sufficient to operate an LC-1A Speaker directly from the output of a 70-C1, 70-C2 or 70-D turntable. The high-gain feature also allows the amplifier to be used in studio talk-back circuits without a pre-amplifier.

## CIRCUIT

### Stages of Amplification

The first stage uses an RCA-1620 triode-connected which, through an interstage volume control, drives another 1620 operated as a pentode. The 6SN7-GT serves as the phase-inverter stage which drives the 1622's in the push-pull output circuit.

### Source and Load Impedance

The input transformer is tapped for a source impedance of 250 ohms or 30 ohms balanced to ground. The output transformer is tapped for connection to a line of 600, 250, 15, 7.5 or 5 ohms.

### Degeneration

Inverse feedback voltage from the tertiary winding on the output transformer is applied to the cathode of the first part of the 6SN7-GT stage. This serves to improve the output regulation and reduces instability caused by fluctuations in the a-c supply voltage and slight variations in the characteristics of the tubes used. Degeneration also reduces distortion and improves the frequency response.

### Power Supply

The self-contained power supply consists of a power transformer and a high-vacuum full-wave rectifier tube followed by a resistance-capacity type filter. An ON-OFF switch is conveniently mounted at the front of the chassis.

### Fuse

A fuse holder is conveniently mounted on the top of the amplifier chassis near the rectifier tube. A type 3AG glass-enclosed fuse having a 3-ampere rating is used.

## INSTALLATION

### Tubes

Place the tubes in the sockets. Markings on the chassis indicate the proper socket for each tube. Mount the two grid caps and two grid-cap shields. Each shield must make a good electrical connection to the shell of the tube to insure noise-free operation.

### Power Transformer Connections

The power transformer T-3 is designed for operation on 105 to 125 volts, 50 to 60 cycles, and is connected at the factory for a line voltage of 115 volts. If the line voltage is above 120 volts, disconnect the 115-volt tap (red and black) and connect the 125-volt tap (black with red tracer) in its place. If the line voltage is below 110 volts, disconnect the 115-volt tap and connect the 105-volt tap (black).

### Mounting

The amplifier is designed for mounting in a Type BR-2A (MI-11598, -A and MI-11599, -A) or Type 36-B (MI-4682) Panel and Shelf Assembly. It may also be mounted inside a Type LC-1A (MI-11401) Speaker Cabinet. Refer to the instruction book furnished with the LC-1A for detailed instructions for mounting the amplifier in the speaker cabinet.

### Procedure for Type BR-2A Panel and Shelf

Mount the dial plate from the adapter kit on the panel (MI-11598, -A), securing it in place with the bushing, washer and nut supplied in the kit. Assemble the parts with the head of the bushing on the inside of the panel to insure clearance.

Assemble the receptacles furnished to two of the U-shaped brackets, supplied with the shelf assembly (MI-11599, -A), by means of four of the fillister-head (6-32) screws furnished with the shelf. Mount the receptacles and brackets in the correct spaces on the shelf with six of the 8-32 round-head machine screws and lockwashers supplied with the shelf.

Attach a guide bar to the shelf on each side of the space which is to receive the amplifier. Use two of the number 4 self-tapping screws supplied with the shelf to mount each guide bar.

Attach the two ejector handles to the amplifier chassis by means of the two pivots, spring washers and C washers supplied with the amplifier. Holes are provided in the handle and chassis so that the head of the supporting pivot will be flush with the face of the handle. The pivot is locked on the inside of the chassis by means of the C washer, which fits into a groove in the pivot and is separated from the chassis by the spring washer.

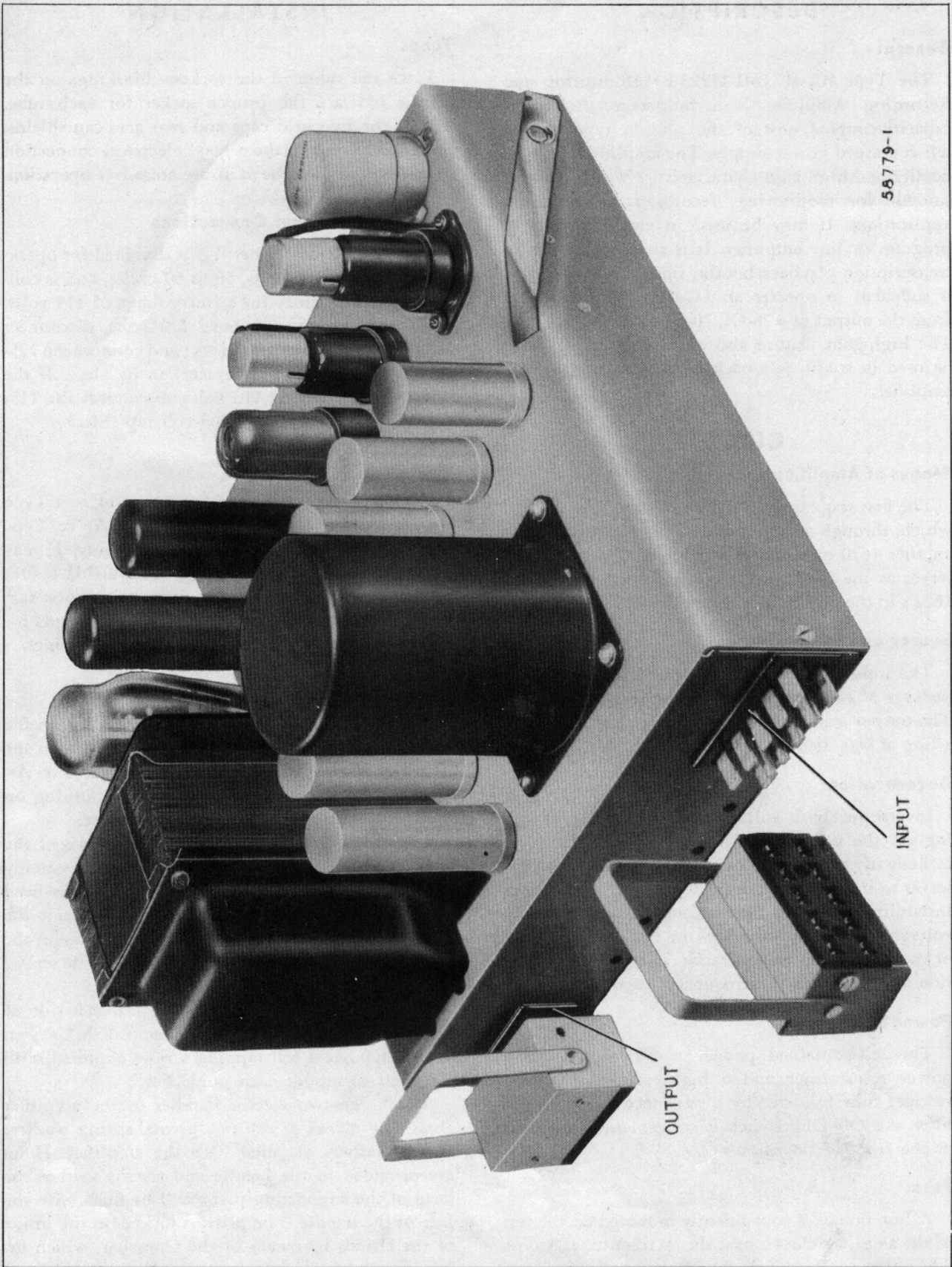


Figure 3—Rear view of Type BA-4C Amplifier.

Slide the chassis onto the shelf so that the rear plugs fit into the receptacles and the hooks of the ejector handles fit into the square holes on the shelf. Push back on the ejector handles to obtain a snug fit. To remove the amplifier, pull forward on the handles and slide it out.

#### Procedure for Type 36-B Panel and Shelf Assembly

Remove the plug button from the hole in the panel through which the shaft of the volume control will project when the amplifier has been installed. Mount the dial plate from the adapter kit, furnished with the amplifier, on the panel, securing it in place with the bushing, washer and nut supplied. Assemble the parts with the head of the bushing on the outside of the panel. Loosen the mounting nuts of the gain control. Adjust the height of the control shaft so that with the amplifier in place on the shelf, the shaft lines up with the hole in the dial-plate bushing in the front panel. Make sure that the locking nuts are securely tightened after these adjustments are made.

Assemble the two "L"-shaped brackets to the rear panel of the amplifier chassis with four of the No. 8-32 round-head machine screws, lockwashers and

nuts supplied. Use the elongated bracket holes and the holes in the rear panel for this purpose. Fasten the chassis to the rear of the shelf by four of the 8-32 round-head machine screws, lockwashers and nuts. Clearance holes are provided in the angle brackets and shelf for this purpose. Fasten the front of the chassis to the shelf with two of the 8-32 round-head machine screws and lockwashers. Tapped holes in the bottom flange of the amplifier chassis and clearance holes in the shelf are used for this purpose. Insert the receptacles into the plugs at the rear of the chassis. Install the knob on the volume control shaft so that the line index will show position 0 when the control is in the extreme counterclockwise position.

**NOTE:** The operating shaft of the volume control is longer than may be required for some applications. The shaft is grooved for convenience in cutting to a shorter length when this is necessary.

#### Receptacle Connections

The connections to the 10-prong receptacles which mate the amplifier plugs are shown in the following tabulation. Refer to figure 3 for the position of the input and output receptacles.

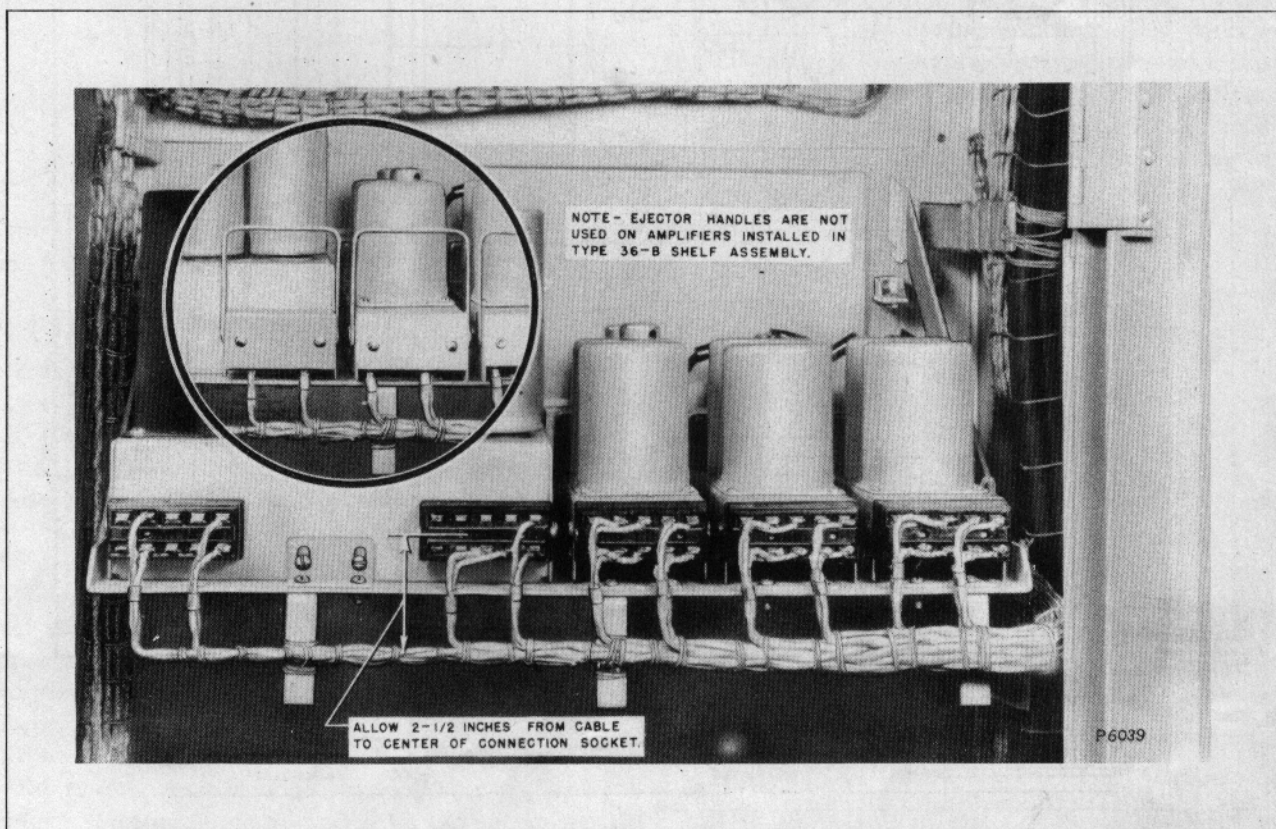


Figure 4—Method of wiring to plug-in units. Insert: Covers in place.



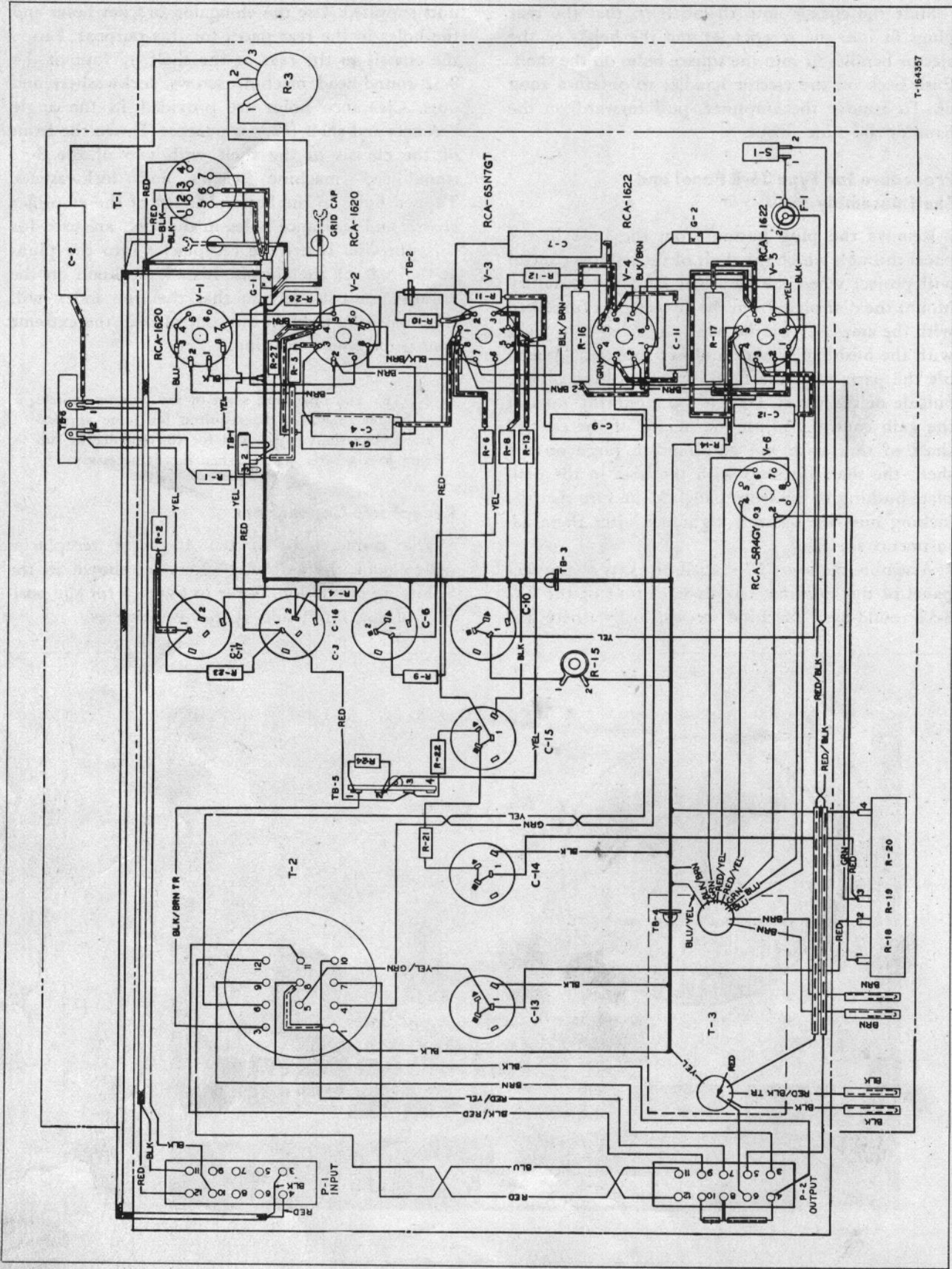


Figure 5—Wiring diagram of BA-4C Amplifier.

## INPUT RECEPTACLE

Terminal No.	Connection
3	30-ohm input
4	30-ohm input
5	No connection
6	No connection
7	No connection
8	No connection
9	No connection
10	Amplifier ground
11	250-ohm input
12	250-ohm input

## OUTPUT RECEPTACLE

Terminal No.	Connection
3	Output transformer—5 ohms unbalanced
4	Output transformer—5 ohms unbalanced
5	A-C input to power transformer
6	A-C input to power transformer
7	Output transformer—7½ ohms unbalanced
8	Output transformer—7½ ohms unbalanced
9	Output transformer—15 ohms unbalanced
10	Output transformer—15 ohms unbalanced
11	Output transformer—600 ohms balanced to ground
12	Output transformer—600 ohms balanced to ground

### Audio Input Connections

All audio input leads should be shielded cable or a shielded, twisted pair. They should be insulated for 200 volts and need not be larger than No. 19 Awg. To prevent undesirable noise pickup, the audio leads should not run adjacent to or be laced in with a-c, loudspeaker field-supply or high-level audio leads.

When a 250-ohm balanced source is used, connect the input leads to terminals 11 and 12 on the input receptacle. Use terminals 3 and 4 on this receptacle when working from a 30-ohm balanced source.

When the input to the amplifier is from an unbalanced source, such as some phonograph pickups, remove the ground connection from the center tap of the amplifier input-transformer primary. To do this, disconnect the lead to terminal number 6 on

T-1. When a ground is desired on one side of the circuit, solder a lead from terminal number 1 on T-1 to the ground terminal G-1 (see wiring diagram, figure 5).

### Audio Output Connections

The secondary of the output transformer is center tapped with the center tap connected to ground. The secondary has six taps which are connected to the output plug P-2. Refer to the *Output Receptacle* table for connections for the various load impedances.

### A-C Power Supply

Connect the a-c power supply for the amplifier to terminals number 5 and 6 of the output receptacle. To insure a low-hum level, shield the a-c supply circuit and ground the shield. Make sure all connections are securely soldered.

## CIRCUIT MODIFICATIONS

### Frequency Compensation

In certain applications, such as when it is desired to improve the output from a loudspeaker, it may be desirable to provide additional gain at either the high-frequency or the low-frequency end of the audio range. This may be accomplished by the installation of resistance-capacity networks for which a kit of parts is supplied with the amplifier. Both the low-frequency and high-frequency gain may be increased in the same amplifier resulting in a frequency response as shown in figure 8.

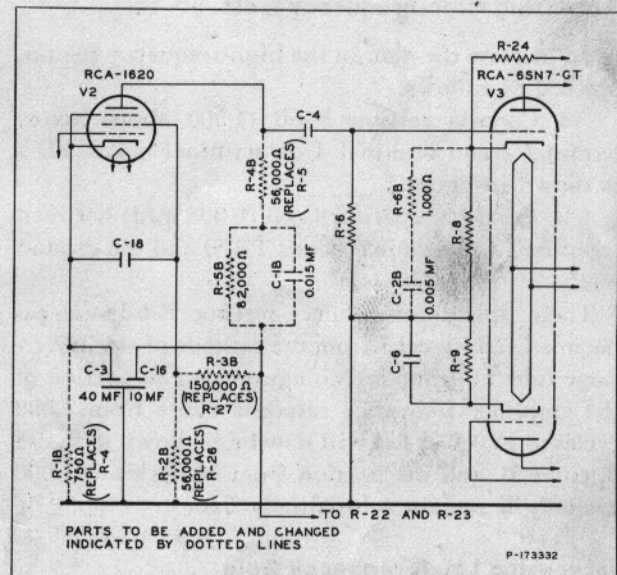


Figure 6—Partial schematic diagram for compensation.

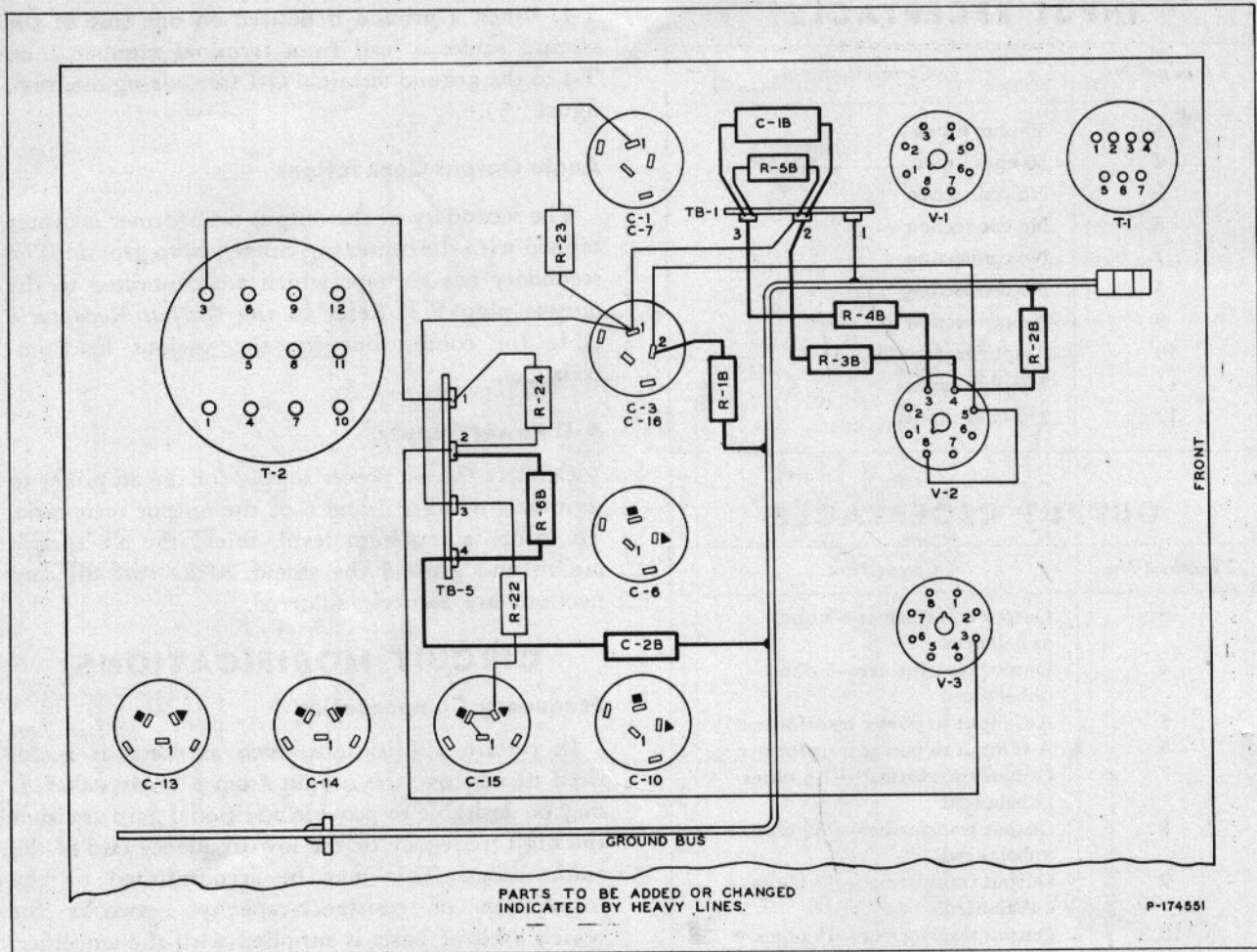


Figure 7—Partial wiring diagram for compensation.

### Increasing High-Frequency Gain

To increase the gain in the high-frequency region, proceed as follows:

- a. Connect resistor R-6B (1,000 ohms) across terminal 2 and terminal 4 on terminal board TB-5 as shown in figure 7.
- b. Connect capacitor C-2B (0.005 mfd) between terminal 4 (on terminal board TB-5) and the ground bus.

These operations connect resistor R-6B and capacitor C-2B in series from the cathode of the driver-stage tube to ground. (See figure 6.) The portion of the amplifier frequency response curve from 1,000 cycles to 15,000-cycles will now be as shown in figure 8, curve B, and the portion from 30 cycles to 1,000 cycles will remain substantially flat.

### Increasing Low-Frequency Gain

To increase the gain in the low-frequency region, refer to figure 7 and make the following changes:

- a. Remove resistor R-5 and connect resistor R-4B (56,000 ohms) from terminal 3 of tube V-2 to terminal 3 on terminal board TB-1. (Terminal 3 was formerly blank.)

NOTE: Terminal board TB-1 stands vertically on the chassis but is shown in the horizontal position in figure 7 for the sake of clarity. Terminal 3 is at the top, terminal 2 in the middle, and terminal 1 at the bottom.

- b. Remove resistor R-27 and replace it with resistor R-3B (150,000 ohms) connecting it from terminal 4 on tube V-2 to terminal 2 on terminal board TB-1.
- c. Connect capacitor C-1B (.015 mfd) and resistor R-5B (82,000 ohms) in parallel across terminals 3 and 2 on terminal board TB-1.
- d. Remove resistor R-26 and replace it with resistor R-2B (56,000 ohms) connecting it from terminal 4 on tube V-2 to the ground bus.
- e. Remove resistor R-4 and replace it with re-

sistor R-1B (750 ohms) connecting it from terminal 2 on capacitor C-16 to the ground bus.

When these changes have been made, the portion of the frequency response curve between 20 cycles and 1,000 cycles will be as shown in figure 8, curve B; the portion from 1,000 cycles to 15,000 cycles will remain substantially flat.

NOTE: It is important to remember that when the power-output level at 60 cycles is 12 watts, the power output level between 1,000 cycles and 15,000 cycles is only 3.8 watts. This means that when the alterations outlined above have been made, the effective power output rating of the amplifier (except for some of the very low frequencies) actually has been reduced to 3.8 watts.

### Overall Gain Reduction

For special applications it may be desirable to operate the BA-4C Amplifier at a lower gain. This may be done by disconnecting the second stage of the amplifier as follows:

- a. Remove the grid lead from the grid cap of the second stage RCA-1620 tube (V-2) and remove the tube from its socket.
- b. Tape the clip on the end of the grid lead to prevent a short circuit.
- c. Disconnect capacitor C-4 from terminal number 1 on the third-stage RCA-6SN7-GT tube (V-3) by unsoldering the capacitor lead at the tube socket.

d. Connect a suitable length of wire from terminal number 2 on the variable resistor R-3 to terminal number 1 on the third-stage RCA-6SN7-GT tube.

These operations disconnect the second stage of the amplifier and connect the output of the first stage to the grid of the third stage. The unit will now operate as a three-stage amplifier with the same characteristics as the normal four-stage amplifier except as noted under *Technical Data for Three Stage Operation* on page 1.

### Bridging Input

The MI-11274-A Remote Volume Control supplied with the amplifier is designed to provide a high-resistance bridging-input circuit for connection between any low-impedance balanced source and the 250-ohm input terminals of the amplifier. This control consists of a 250-ohm dual potentiometer, a 470-ohm resistor, two 4,700-ohm resistors and a terminal board. Refer to figure 10 for the schematic diagram. This volume control makes it possible to pick up program material from a zero-level program bus or other low-impedance terminated line without disturbing the characteristics of the line. When a step-type control is desired, an MI-11709 Bridging Volume Control may be ordered separately. The electrical characteristics for the MI-11274-A listed below apply also to the MI-11709.

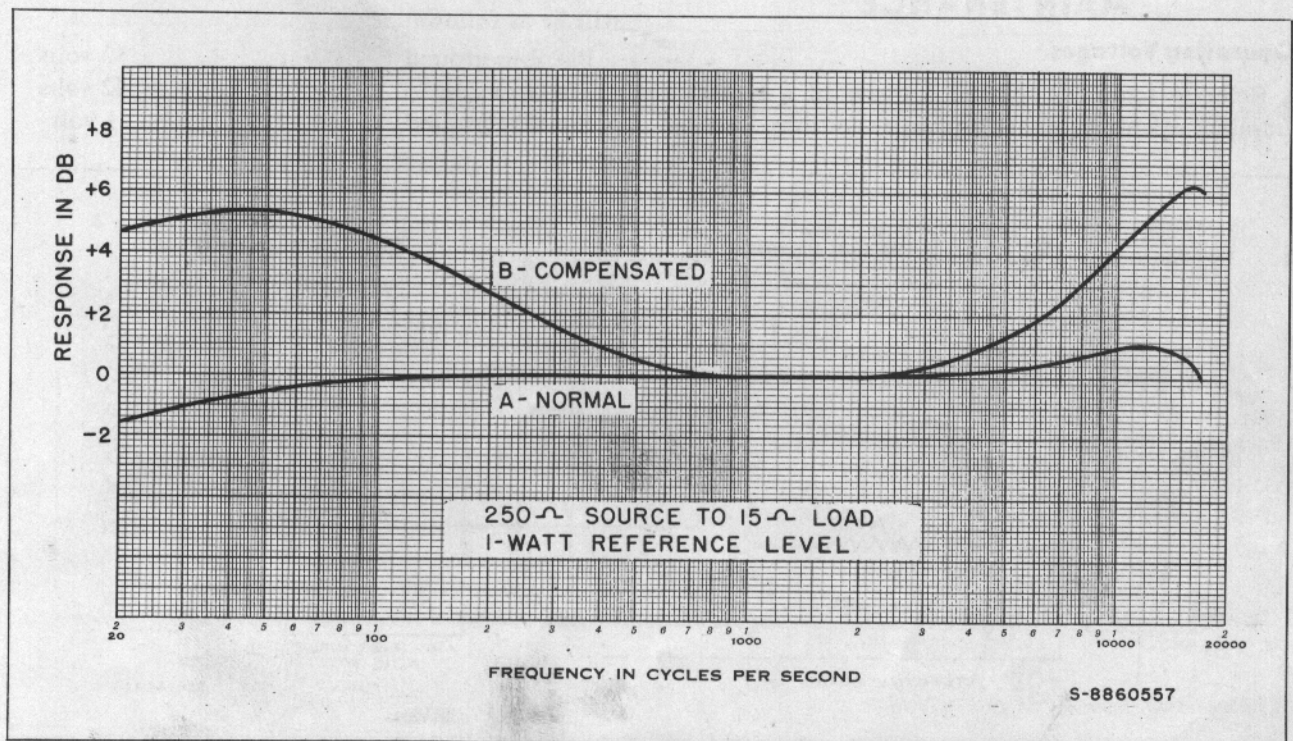


Figure 8—Frequency response.

## MI-11274-A TECHNICAL DATA

### Input Impedance

10,000 ohms approximate

### Insertion Loss

32 db when bridging a 600-ohm line and operating into a 250-ohm amplifier input (control in maximum position).

### Output Impedance

250 ohms

### Dimensions and Weight

Overall dimensions (not including shaft):

Height—2 $\frac{3}{8}$  inches

Width—1 $\frac{1}{2}$  inches

Depth—1 $\frac{1}{2}$  inches

Weight—4 $\frac{1}{2}$  ounces

### Mounting

Panel mounting

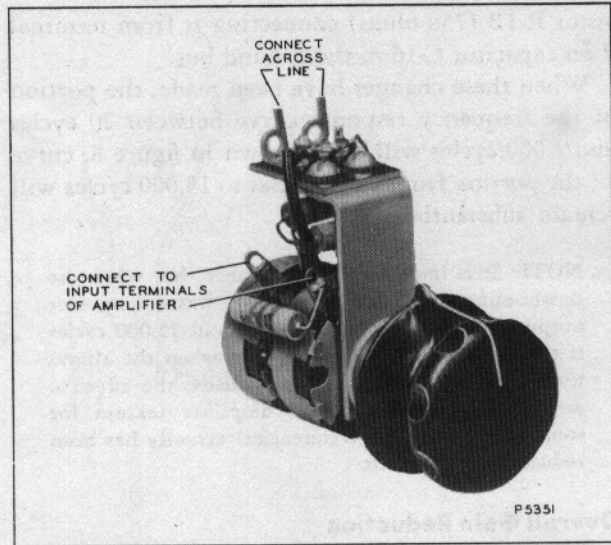


Figure 9—MI-11274-A Volume Control (front view).

### Installation of MI-11274-A Volume Control

To mount the MI-11274-A Volume Control, drill a 7/16-inch diameter hole in a panel and install the volume control by means of the nuts and washers supplied. See figures 9 and 11 for the proper connections to be made to the control. See figure 10 for a diagram showing the amplifier receptacle terminals to be used.

## MAINTENANCE

### Operating Voltages

Refer to figure 12 for the voltages of a typical amplifier operating under normal conditions. Use a

meter having an internal resistance of 20,000 ohms-per-volt or higher when reading the values of d-c voltage shown. The voltages listed are nominal, and readings taken should not vary more than about 5 per cent of the values given.

### Changes in Socket Voltages with Compensation

When the low-frequency gain is increased by adding the necessary parts as described above, the socket voltages of the second stage RCA-1620 tube will be as follows:

Pin P to ground .....	50 volts
Pin G to ground .....	42 volts
Pin K to ground .....	1 volt

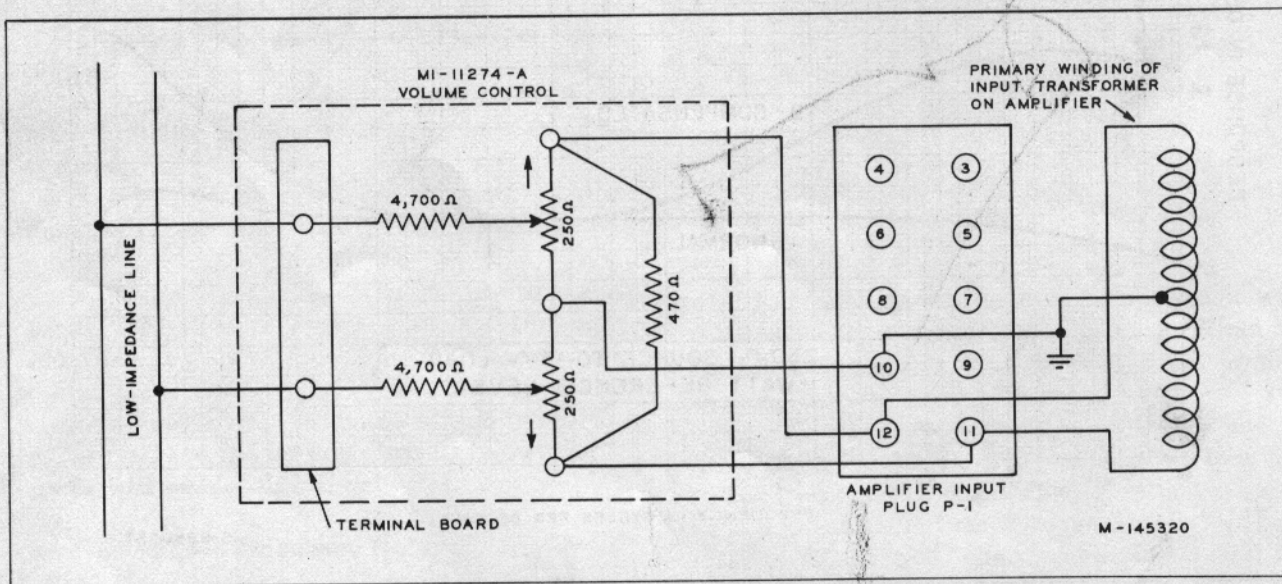


Figure 10—MI-11274-A Remote Volume Control, schematic diagram.

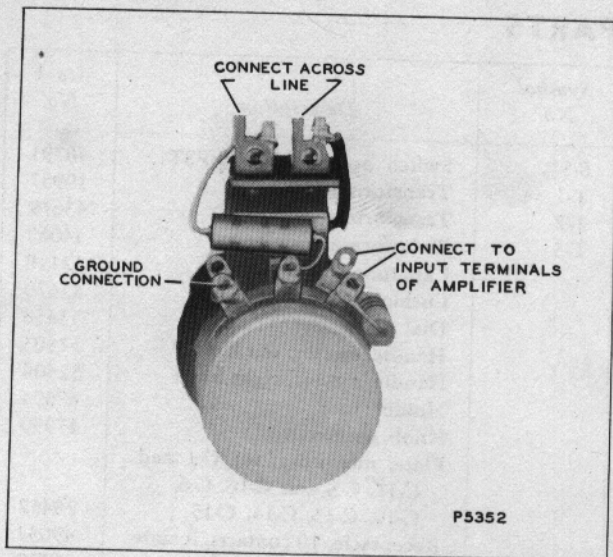


Figure 11—MI-11274-A Volume Control (rear view).

**Cleaning**

The care of the amplifier should include the usual precautions observed in the maintenance of high quality speech-input components. Do not allow dust or dirt to accumulate on the equipment. Perform the following operations at regular intervals:

- a. Check the tubes for normal characteristics. Label each tube, indicating condition and length of service.
- b. Clean the tube prongs and tube sockets.
- c. Keep the prongs of the amplifier connection plug clean.

**Fuse Replacement**

When replacing a blown fuse, make sure that the replacement fuse is of the same type and rating (3 amperes, type 3AG, stock number 10907) as the one furnished with the amplifier. Do not use a fuse of higher rating for replacement purposes, since this will needlessly endanger the windings of the power transformer.

**REPLACEMENT PARTS**

The following parts list is included to provide identification when ordering replacement parts. Order from *RCA Replacement Parts Department, Camden, New Jersey*, giving the *Stock Number* and *Description* of the parts wanted. Replacement parts supplied may be slightly different in form or size from the original parts but will be completely interchangeable with them.

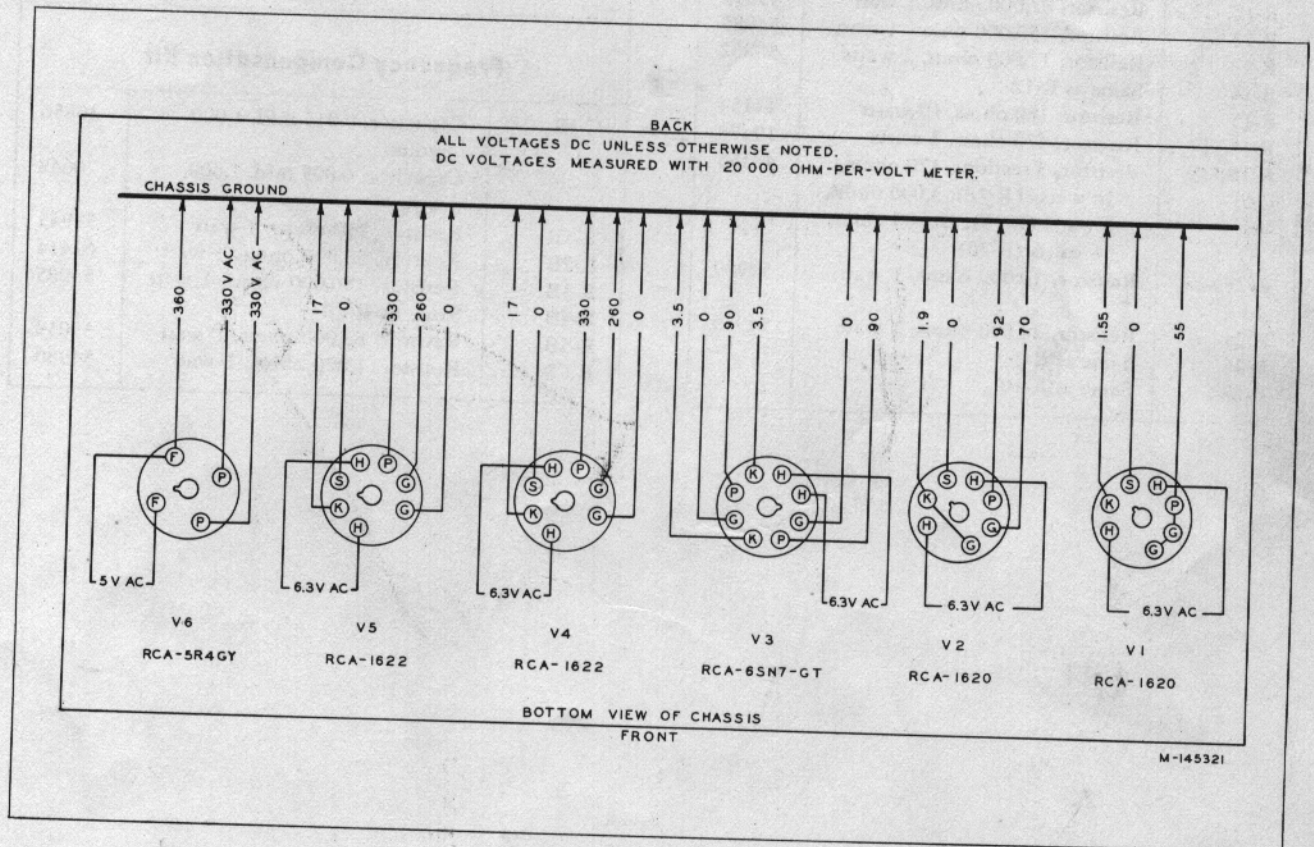


Figure 12—Socket voltages.

## LIST OF PARTS

Symbol No.	Description	Stock No.
C-1, -17	Capacitor, two sections, comprising one 10 mfd, 450 volts; and one 40 mfd, 25 volts	53003
C-2	Capacitor, 0.1 mfd, 500 volts	70638
C-3, -16	Same as C-1	
C-4	Same as C-2	
C-6	Capacitor, 40 mfd, 150 volts	53002
C-7, -9	Same as C-2	
C-10	Same as C-6	
C-11, -12	Capacitor, 0.0025 mfd, 1,000 volts	54940
C-13, -14	Capacitor, 40 mfd, 450 volts	37308
C-15	Capacitor, 20 mfd, 450 volts	32400
C-16	See C-3	
C-17	See C-1	
C-18	Capacitor, 1 mfd, 150 volts	70620
F-1	Fuse, 3 amperes, 250 volts	10907
P-1, -2	Plug, 10 contacts, male	48788
R-1	Resistor, 1,500 ohms, 1 watt	54987
R-2	Resistor, 100,000 ohms, 1 watt	65433
R-3	Resistor, variable, 250,000 ohms	53841
R-4	Resistor, 1,000 ohms, 1 watt	54986
R-5	Resistor, 47,000 ohms, 1 watt	71988
R-6	Resistor, 470,000 ohms, 1 watt	54988
R-8, -9	Resistor, 2,700 ohms, 1 watt	90383
R-10, -11	Resistor, 82,000 ohms, 1 watt	39059
R-12	Resistor, 150,000 ohms, 1 watt	54985
R-13	Resistor, 12,000 ohms, 2 watts	50862
R-14	Same as R-12	
R-15	Resistor, 180 ohms, 10 watts	44154
R-16, -17	Resistor, 470 ohms, 2 watts	19478
R-18, -19, -20	Resistor, 3 sections, 170 ohms, 16 watts (R-18); 3,000 ohms, 8 watts (R-19); 18,000 ohms, 16 watts (R-20)	44155
R-21, -22, -23	Resistor, 10,000 ohms, 1 watt	54989
R-24	Resistor, 24,000 ohms, 1 watt	54939
R-26	Same as R-2	
R-27	Same as R-10	

Symbol No.	Description	Stock No.
S-1	Switch, power, toggle, SPST	48791
T-1	Transformer, input	19957
T-2	Transformer, output	43679
T-3	Transformer, power	44068
	Cap, tube shield	12110
	Cushion, socket mounting	45470
	Dial plate	53458
	Handle, ejector, left hand	52403
	Handle, ejector, right hand	52404
	Holder, fuse	48894
	Knob, gain control	27990
	Plate, mounting; for C-1 and C-17, C-3 and C-16, C-6, C-10, C-13, C-14, C-15	28452
	Receptacle, 10 contacts, female	49032
	Socket, tube, for V-2, V-3, V-4, V-5, V-6	31319
	Socket, tube, floating, for V-1	28413
<b>Remote Volume Control</b>		
R-1A	Resistor, 470 ohms, 1 watt	68033
R-2A, -3A	Resistor, variable, 2 sections, 250 ohms each section	18552
R-4A, -5A	Resistor, 4,700 ohms, 1 watt	69570
	Knob, volume control	17268
<b>Frequency Compensation Kit</b>		
C-1B	Capacitor, 0.015 mfd, 1,000 volts	30856
C-2B	Capacitor, 0.005 mfd, 1,000 volts	70648
R-1B	Resistor, 750 ohms, 1 watt	54945
R-2B	Resistor, 56,000 ohms, 1 watt	62414
R-3B	Resistor, 150,000 ohms, 1 watt	54985
R-4B	Same as R-2B	
R-5B	Resistor, 82,000 ohms, 1 watt	39059
R-6B	Resistor, 1,000 ohms, 1 watt	54986

